

***NASA Aviation Safety Program
(AvSP)***

***Weather Accident Prevention Project
(WxAP)***

***Weather Information Communications Element
(WINCOMM)***

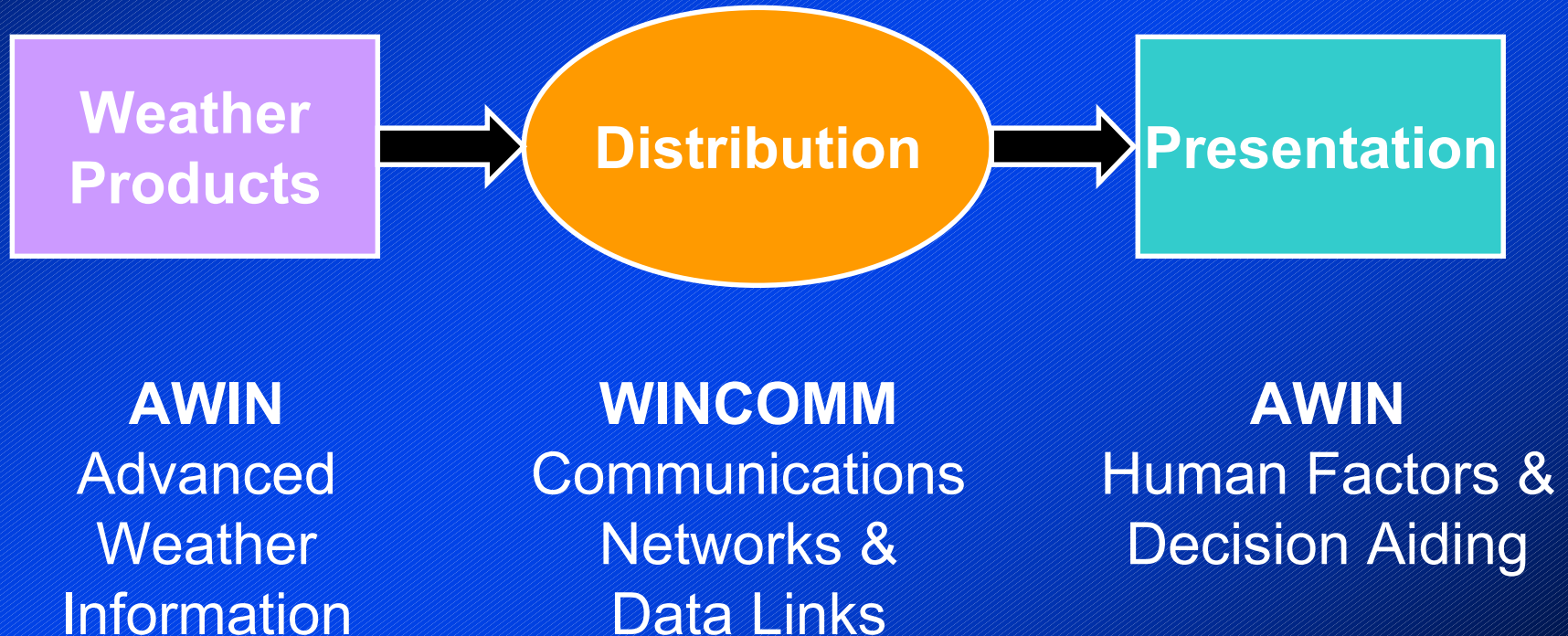
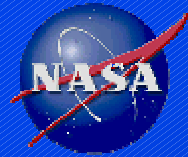
WxAP Annual Review – Status
November 20, 2002

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System Elements



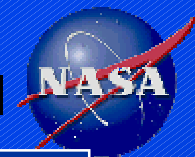
WxAP: Weather Information Communications



WINCOMM Plan

AVSP

WxAP: Weather Information Communications



Goal

Develop advanced communications and information technologies to enable the high quality and timely dissemination of strategic weather information between the flight deck and ground users.

Objectives

Develop Advanced
Communication
Datalinks

Develop Advanced
Communication
Networks

Challenges

Integration into the
Existing NAS
Structure

Compatibility with
Current and
Planned Equipage

Provision of Value
Encouraging
Voluntary Equipage

Diverse Aircraft Base from General Aviation to Transport/Cargo

Approach

Define Weather
Communication
Requirements

Assess Current
Infrastructure. Identify
Technology Shortfalls
and Gaps

Apply/Develop Technologies
to Satisfy Gaps Leveraging
Broad Base Commercial
Systems where Possible

Process

Requirements and
Architectures

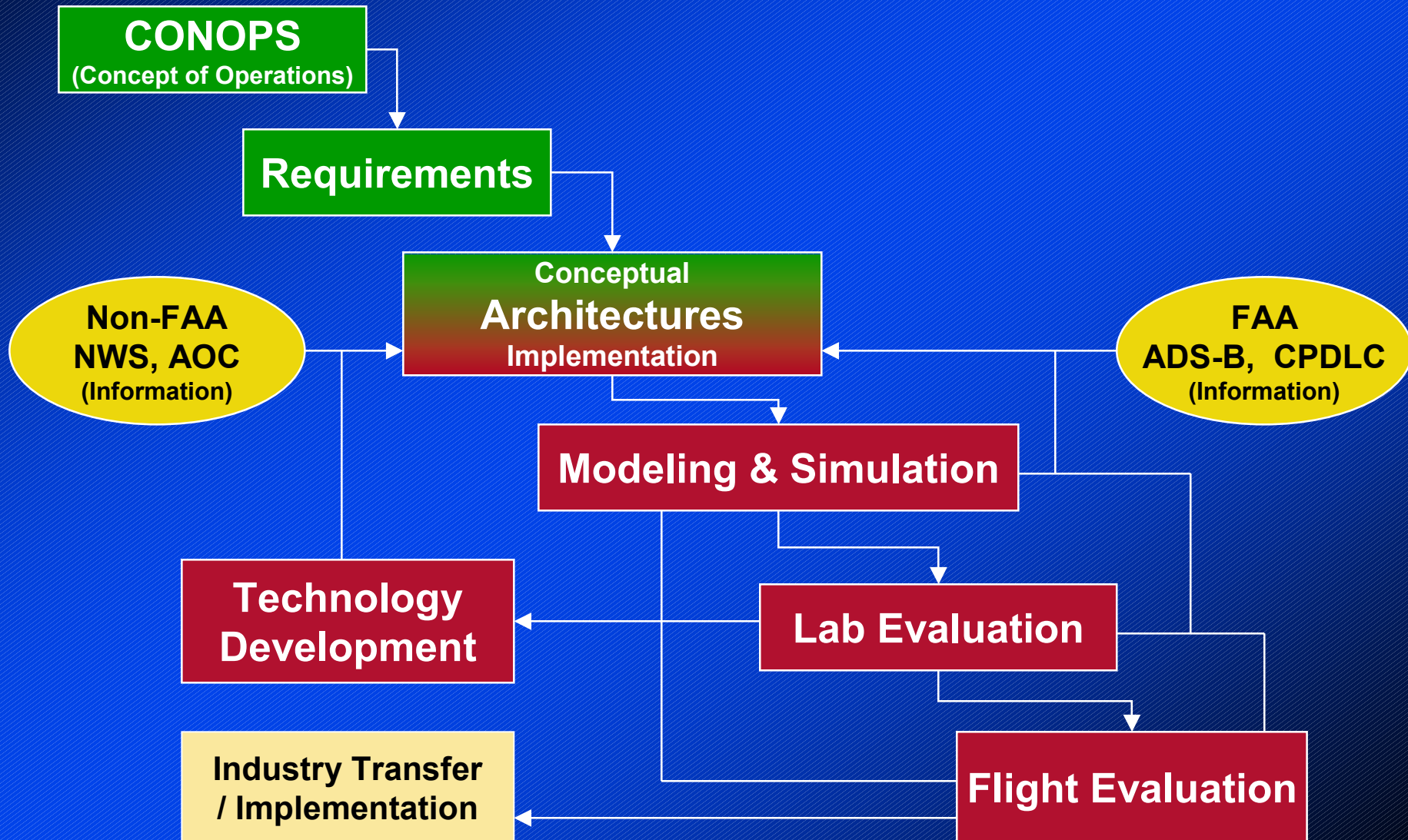
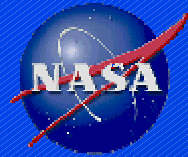
Modeling and
Simulation

Technology Development
and/or Validation

Development Process



WxAP: Weather Information Communications



Technical Development Scope

AVSP

WxAP: Weather Information Communications



Far-Term (2007-2012)

National

Airline Commercial Transport

Low-end General Aviation

**Oceanic /
International**

Flight Deck End-Users

Surface

Terminal Area

En-Route

Aviation Datalink Evolution



WxAP: Weather Information Communications



Existing Aircraft Datalinks

**Small, Short Messages
&
Low Volume**

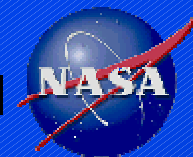
Future Aircraft Datalinks

**Large, Extended, Variable Length Messages
&
High Volume**

In-Flight Weather Information



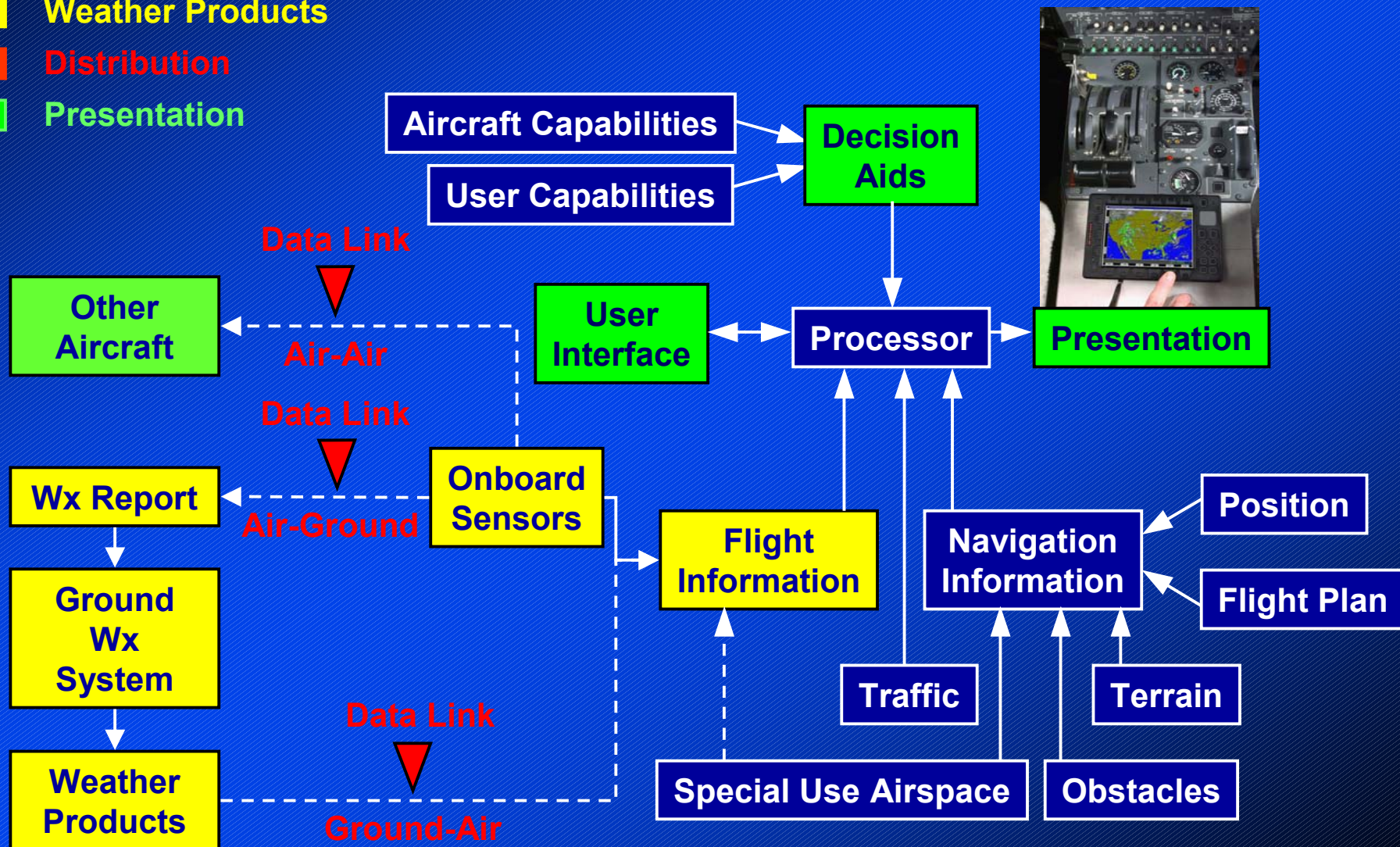
WxAP: Weather Information Communications



Weather Products

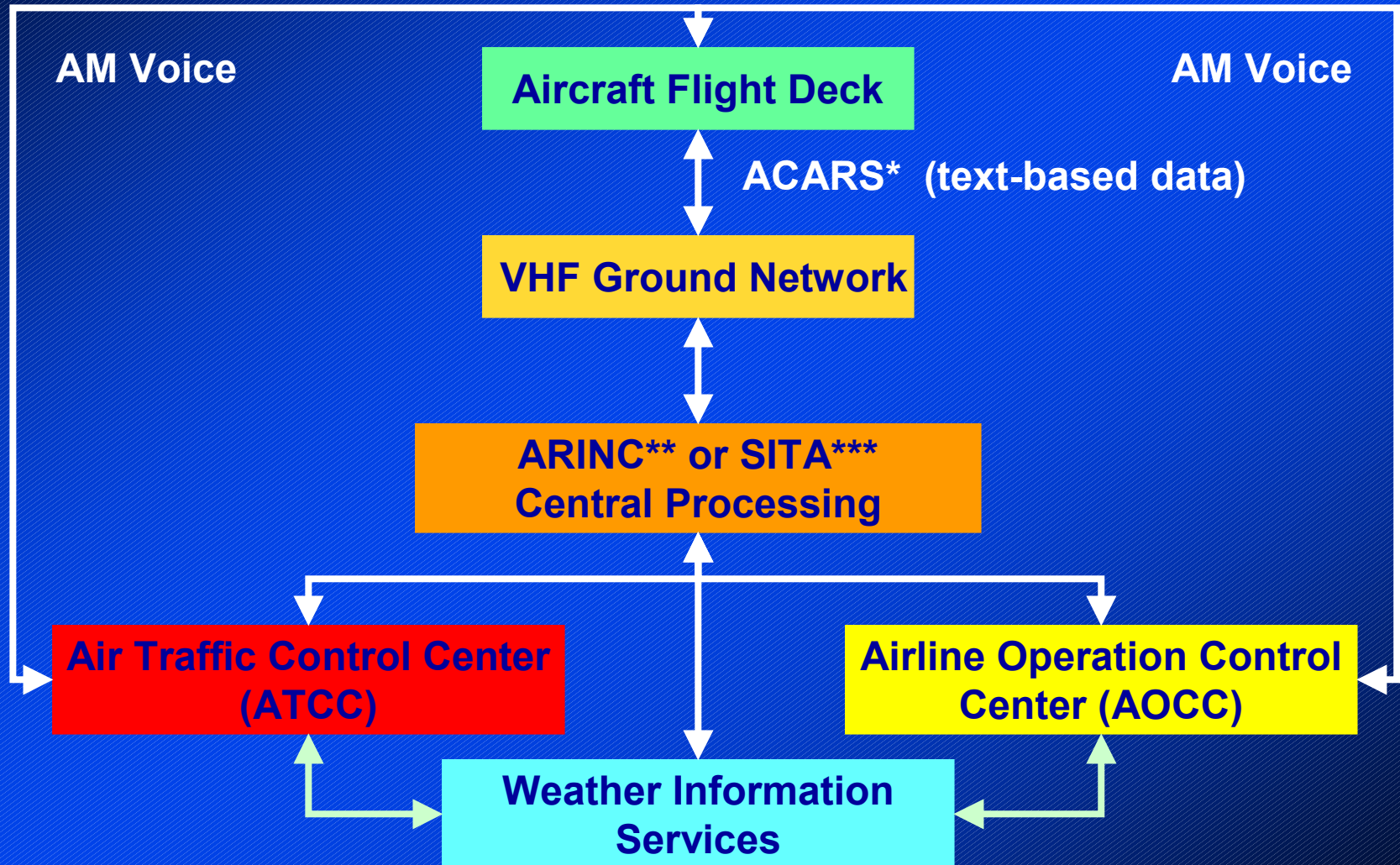
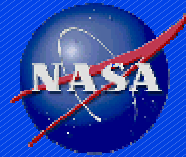
Distribution

Presentation



Primary Commercial Aviation Links

WxAP: Weather Information Communications



* Aircraft Communications Addressing and Reporting System

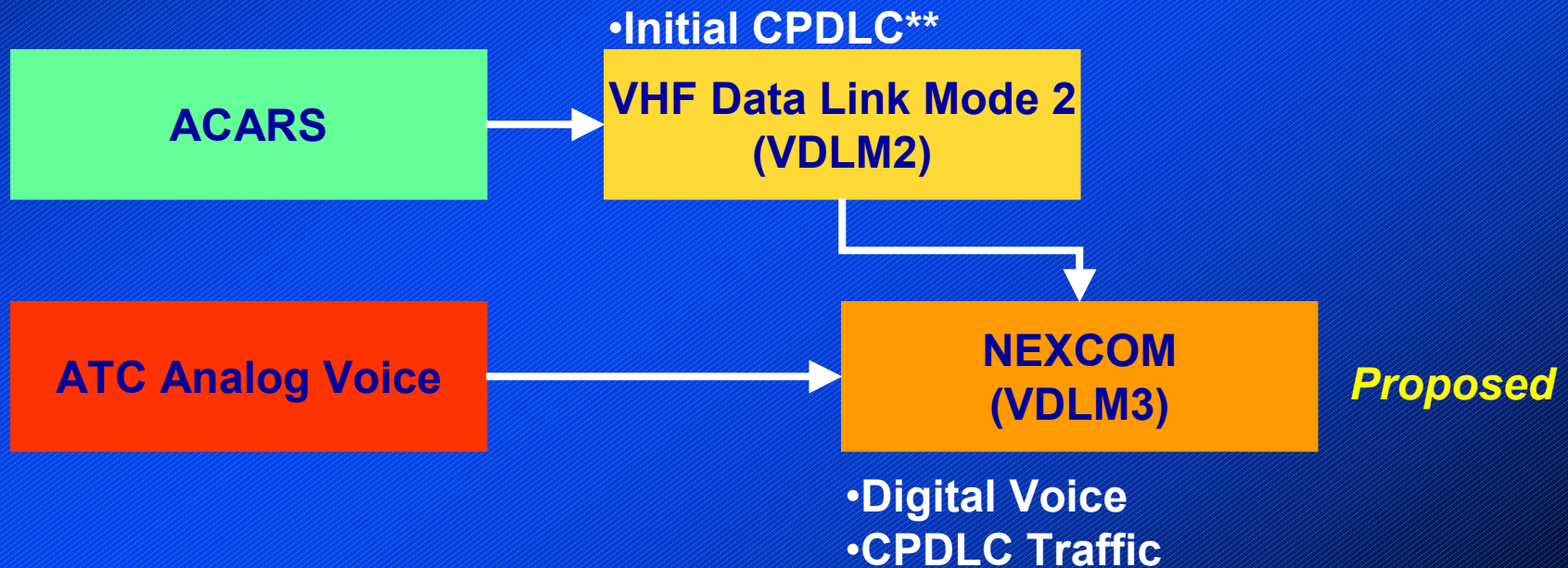
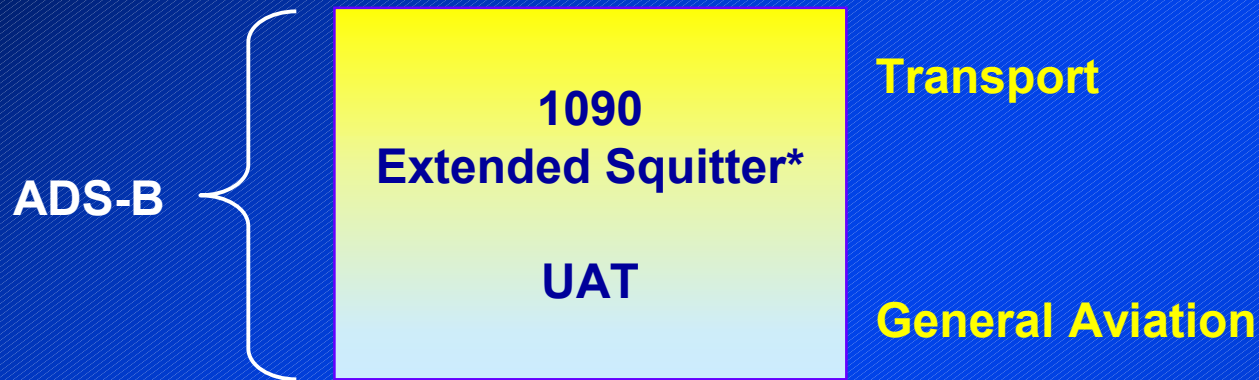
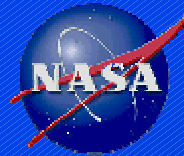
** Aeronautical Radio Incorporated

*** Societe Internationale Telecommunications Aeronautique

Awareness of FAA Link Planning



WxAP: Weather Information Communications



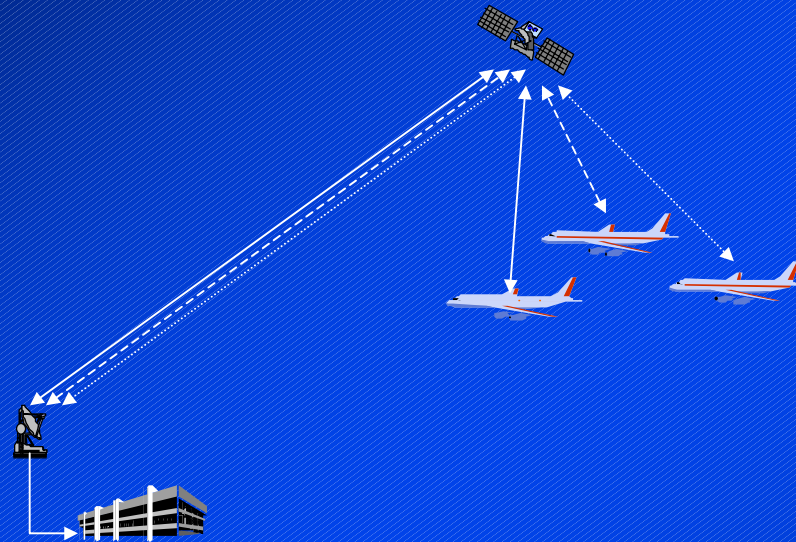
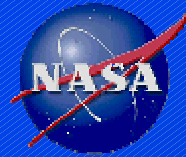
*Modified Mode-S

**Controller-Pilot Data link Communications

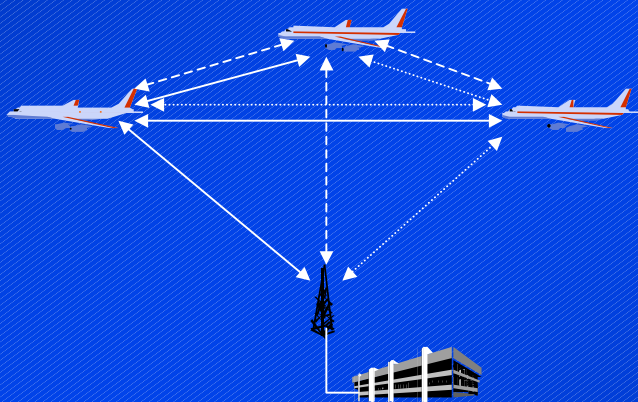
Aviation Datalink Architectures

AVSP

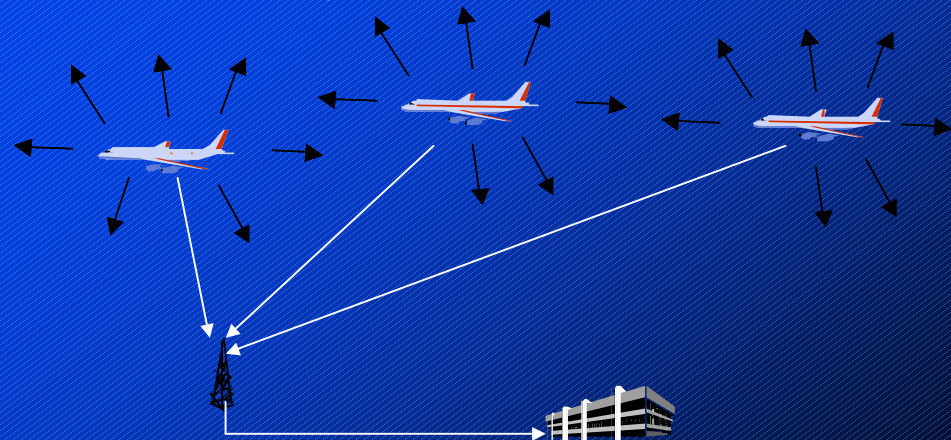
WxAP: Weather Information Communications



SATCOM-Only (Broadcast & 2-Way)



Terrestrial Air/Ground & Air/Air 2-Way



Terrestrial Air to Ground & Air to Air Broadcast

Architecture, Modeling & Simulation

AVSP

WxAP: Weather Information Communications



Architecture Studies Completed this year

2003
TAMDAR

2007/2015
TAMDAR

2007/2015
FIS

ADS-B FIS Modeling & Simulation Completed this year

UAT

1090
Extended
Squitter

VDLM4

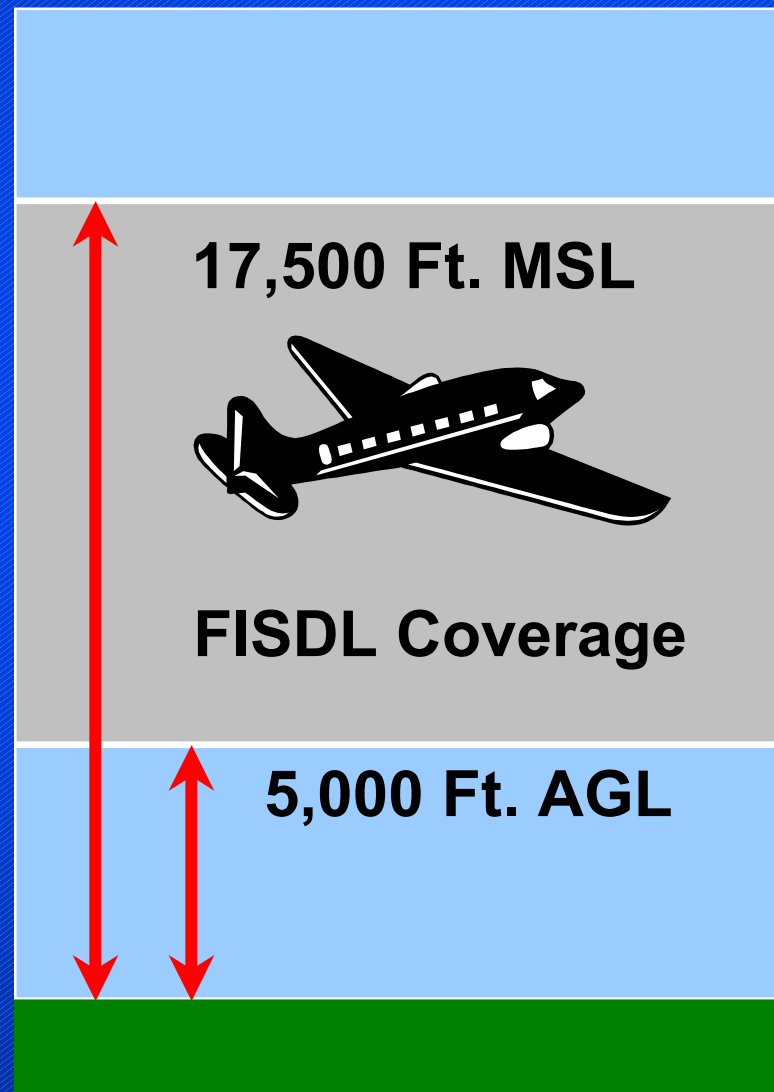
Flight Information Services Datalink

AVSP

WxAP: Weather Information Communications



- FAA & industry implementation
- G/A focused service volume
- 2 vendors (Honeywell & ARNAV)
- 5 year contract (FY00-04)
 - July 1999 - Selection
 - July 2001 - Initial rollout
- 2 national VHF frequencies/vendor
- Free text weather products
- Fee-based value/graphical products



ARNAV CRA



WxAP: Weather Information Communications



- **Phase 1: Addressed near-term need for broadcast of graphical weather to the G/A cockpit**
 - **VHF-based line-of-sight broadcast datalink solutions**
 - **Completed in December 2000**
 - **Development leading to Flight Information Services Data Link (FISDL) award**
- **Phase 2: Addressed some of the gaps from Phase 1 (Spectrum, Bandwidth, Coverage)**
 - **Completion in December 2002**
 - **Focus on weather product development**
- **Significant Accomplishments**
 - **1st generation development of weather to GA cockpit capability**
 - **Awarded FISDL policy contract to provide approved cockpit weather products**

NavRadio (Honeywell) CRA



WxAP: Weather Information Communications



- Phase 1: Addressed near-term need for broadcast of graphical weather to the G/A cockpit
 - VHF-based line-of-sight broadcast datalink solutions
 - Completed in April 2001
 - Development of Proof of Concept VDL-Broadcast Radio leading to FISDL award
- Phase 2: Addressed some of the gaps from Phase 1 (Spectrum, Bandwidth, Coverage)
 - Completion in January 2004
 - Redesigned radio for 2-way communications
 - Developing VDLM2 on a chip
- Significant Accomplishments/Plans
 - 2-way ability, National FISDL Network, SARPS compliant radio
 - VDLM2 on a chip will reduce cost, size, weight, and power consumption

NavRadio  Bought By AlliedSignal/ Bendix King  Merged With Honeywell

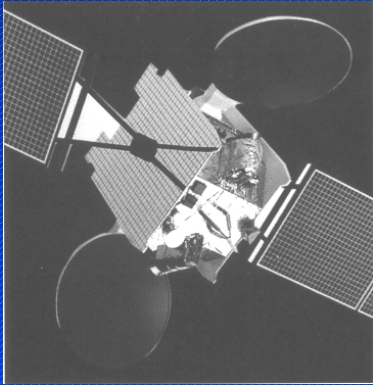
Satellite Weather Information System (SWIS)

WxAP: Weather Information Communications

Phase I: G/A Feasibility

Flight test and evaluation of worldwide weather datalink capability using broadcast Satellite Digital Audio Radio Services (S-DARS).

Johannesburg, South Africa
September, 1999



AfriStar Satellite



*Patch Antenna Mounted to
Cessna 172*



*Internal Equipment (GPS, Laptop
Computer, etc.)*



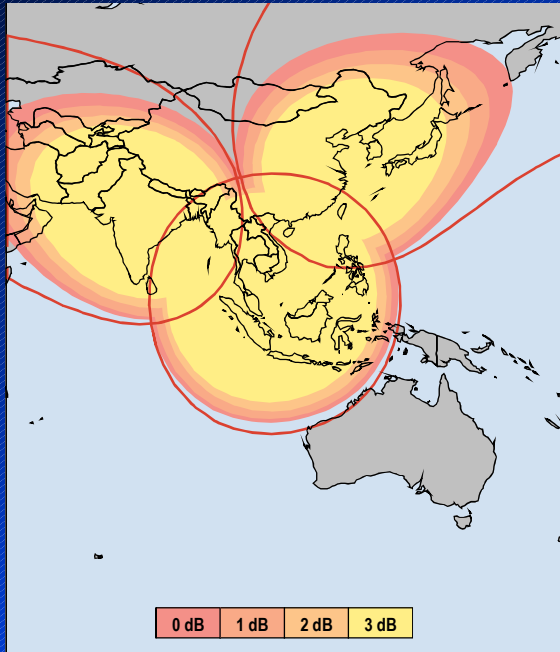
*Satellite
Receiver*

Cooperative Agreement with Rockwell Collins,
WorldSpace, Jeppesen, and American Airlines.

SWIS / S-DARS Phase 2

AVSP

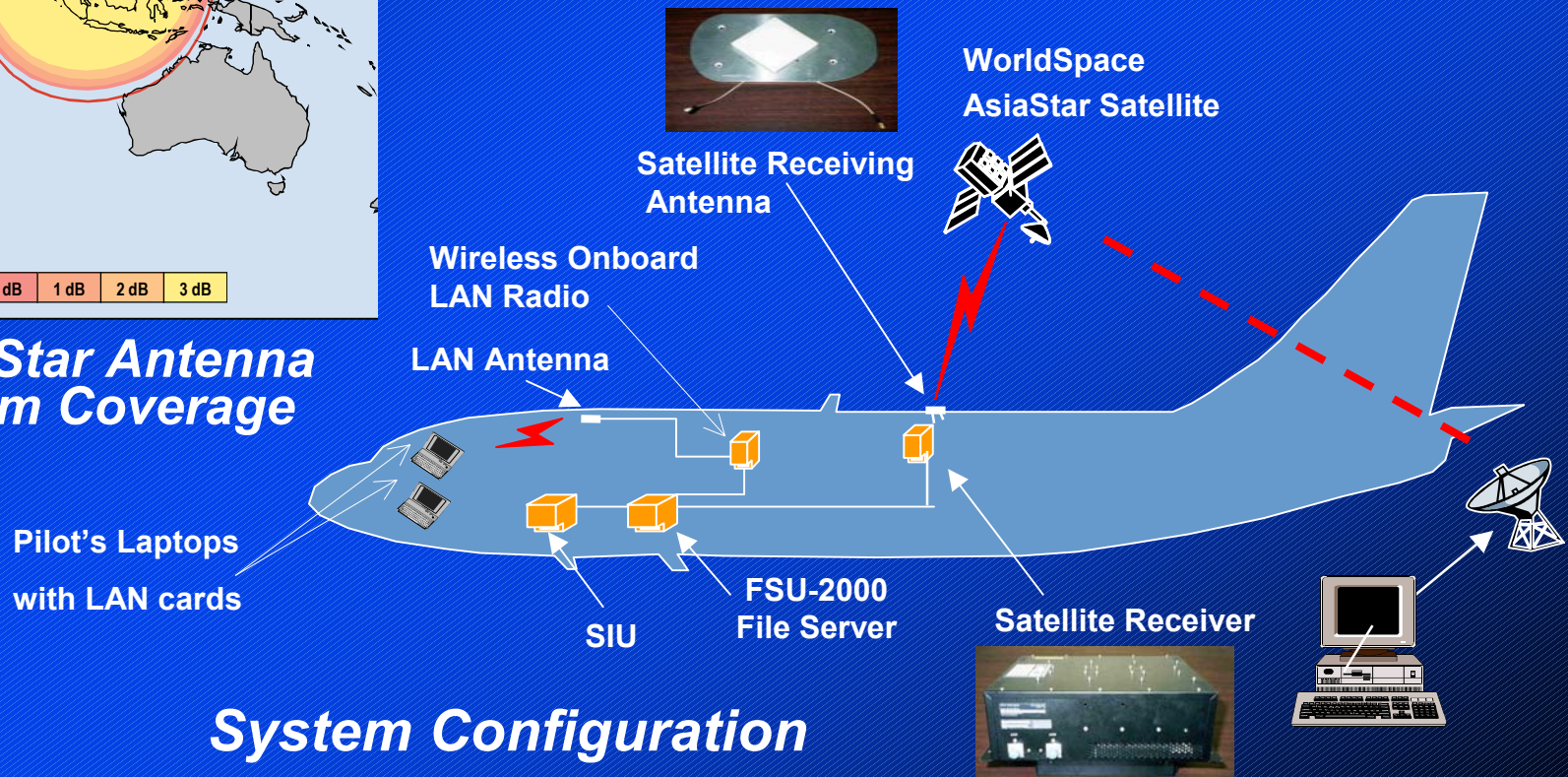
WxAP: Weather Information Communications



**AsiaStar Antenna
Beam Coverage**

Worldwide Transport

Technology development and operational evaluation
of graphical weather to the cockpit via broadcast
SATCOM for commercial transport oceanic
operations

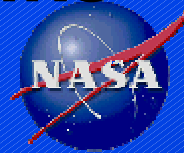


System Configuration

General Aviation: Satellite-based Datalinks

AVSP

WxAP: Weather Information Communications



SBIR with Vigyan
completed in
January 2002

PWA™ airborne
weather display

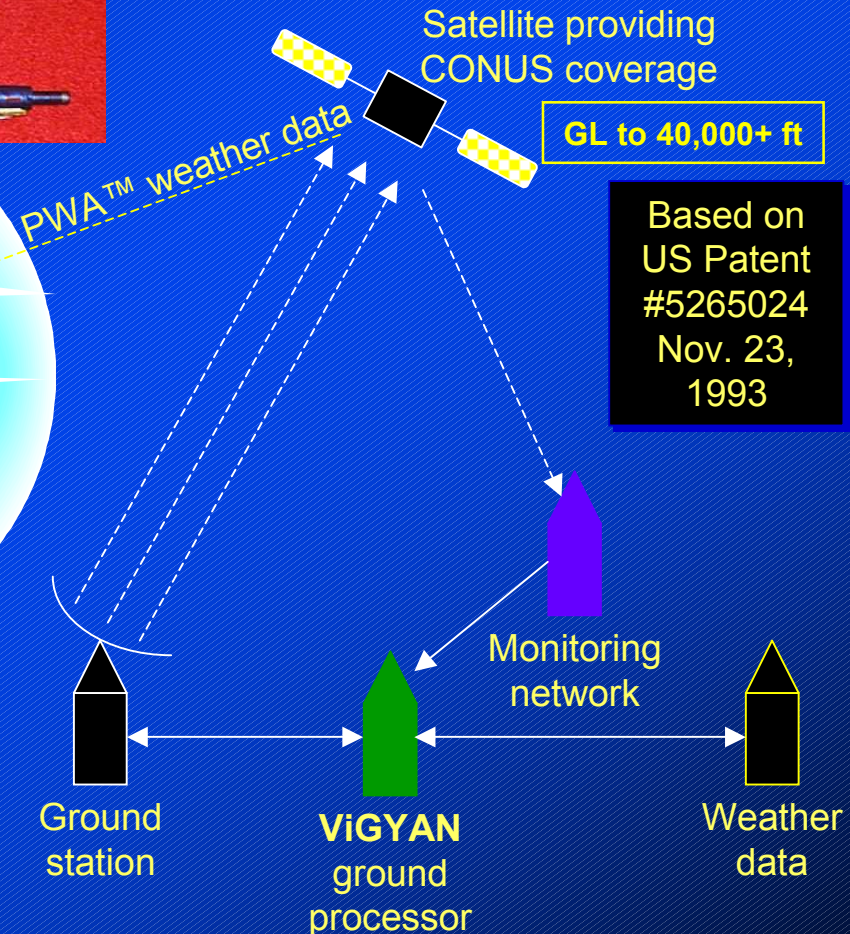


Pilot Weather Advisor™



PWA™
antenna

PWA
receiver

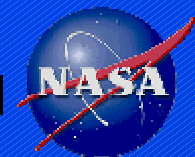


Vigyan PWA Spin Off → WxStream Bought By → WSI

Technology Validation



WxAP: Weather Information Communications



GRC Twin Otter

GRC LearJet



Flight Test Platforms



LaRC B757

Low-Altitude TAMDAR Reporting

WxAP: Weather Information Communications



Use aircraft operating below 20,000 ft altitude to sense and report

- Moisture
- Temperature
- Winds

to be used by

- Forecast models
- Weather briefers
- Controllers
- Other aircraft

MDCRS &
AMDAR Coverage
from Transports

20,000 ft. MSL

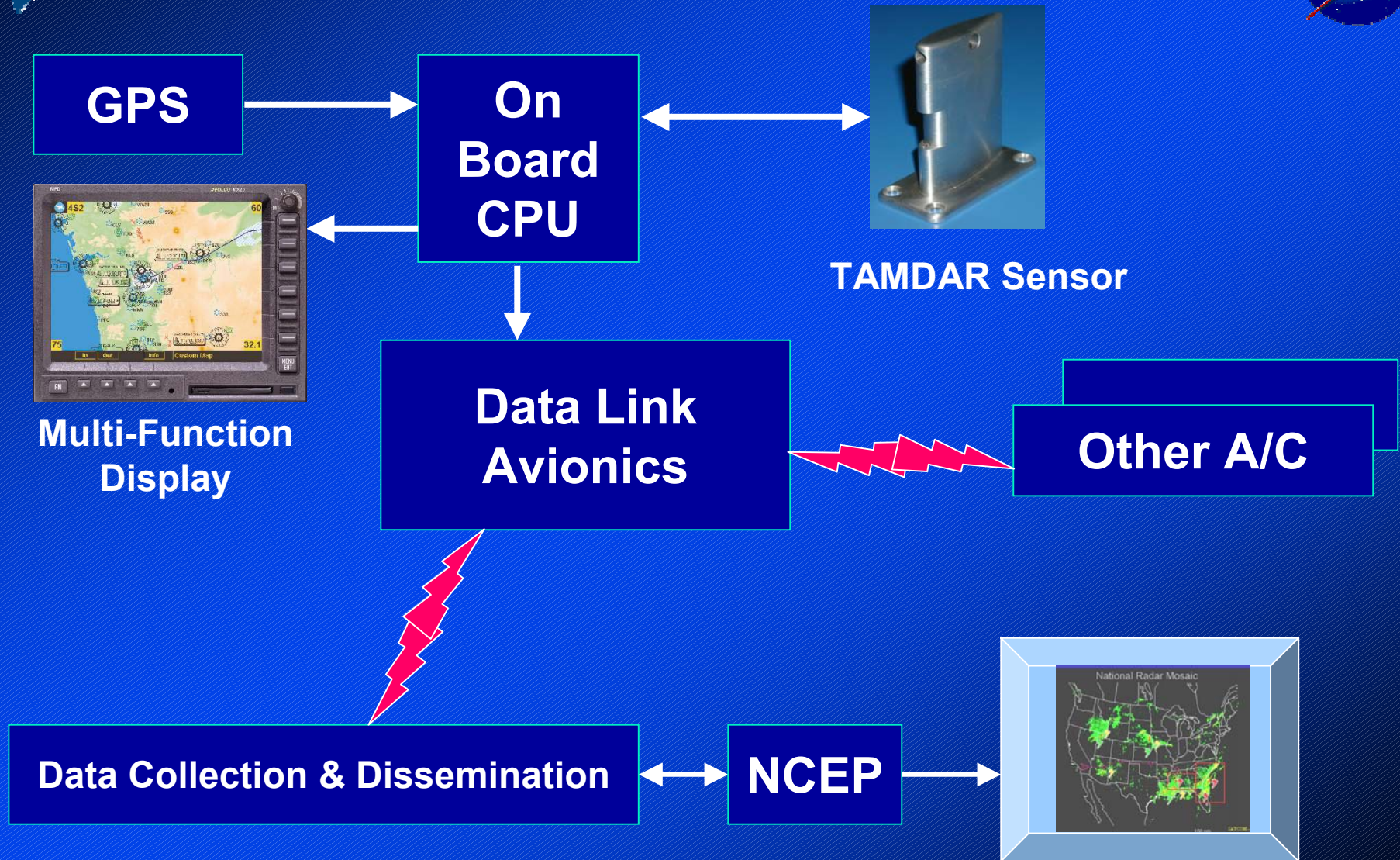
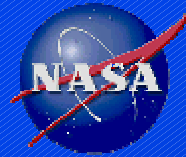


TAMDAR
Coverage

Ground Level

TAMDAR Architecture

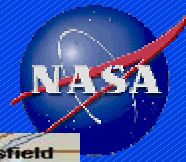
WxAP: Weather Information Communications



TAMDAR POC Flight

AVSP

WxAP: Weather Information Communications



Flight Equipment Racks



Flight Tracks, 1/25/02

Orbcomm (Echoflight) & UAT Datalinks used to transfer TAMDAR messages



TAMDAR Sensor



GRC
Twin Otter

FY02 WxAP Flight Campaign

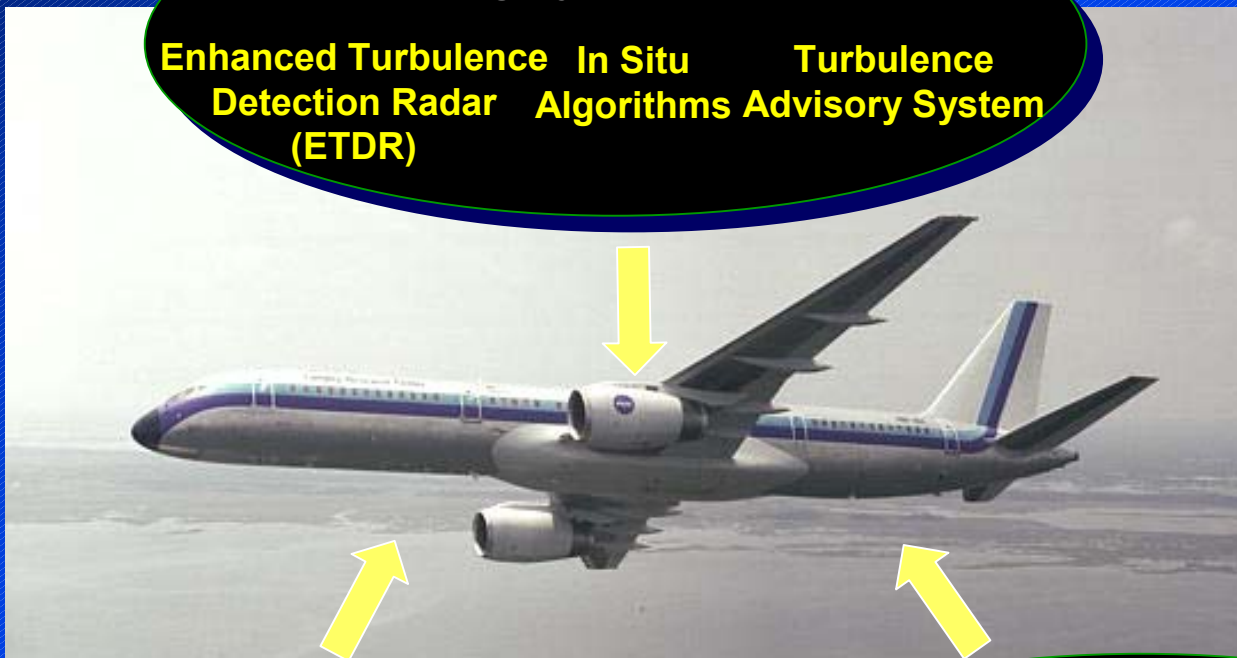
AVSP

WxAP: Weather Information Communications



**Turbulence Prediction &
Warning Systems (TPAWS)**

**Enhanced Turbulence In Situ Turbulence
Detection Radar Algorithms Advisory System
(ETDR)**



**Aviation Weather Information
(AWIN)**

**Aviation Hazard Awareness System
(AHAS) Enhanced Weather
Radar (EWxR)**

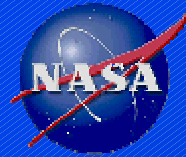
**Weather Information Communications
(WINCOMM)**

**Satellite Communication
(SATCOMM) Datalink**

Broadband SATCOM Datalink

AVSP

WxAP: Weather Information Communications



Ku-band SATCOM



Airborne Equipment Rack

Phased Array Antennas



LaRC B757

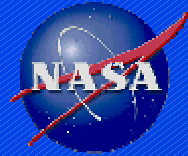
FY02 Flights

- Graphical weather images were received onboard the aircraft.
- Turbulence information was transmitted from and received onboard.

Summary



WxAP: Weather Information Communications



- Architecture studies have narrowed the field of datalink candidates capable of satisfying weather information communication requirements.
- Modeling in simulated operational environments continues to refine initial architecture studies and provide a sound basis for future focused efforts.
- Technology demonstrations have provided an early assessment of the ability of various datalinks to distribute weather information.
- Starting with FY03, WINCOMM will focus on specific scenarios and associated datalinks to address the remaining challenges and provide feasible solutions.